Warm up

1. Give three other points that are the same as (2, 50°)

$r = 5\cos\theta$

Convert the following rectangular coordinates to polar. Give with a positive angle and negative r.

2. (-4, -5)

3. (-3, 7)

$r = 5\sec\theta$

$r = 5\frac{1}{\cos\theta}\cos\theta$

$\cos\theta$

Convert the following polar equations to rectangular

4. r = 5secθ

$x = 5$

5. $r^2 = 6^2$

$x^2 + y^2 = 36$

$r\cos\theta = 5$

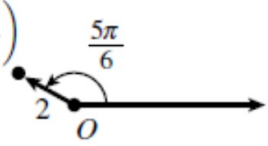
$x = 5$

In Exercises 7–14, plot the point with the given polar coordinates.

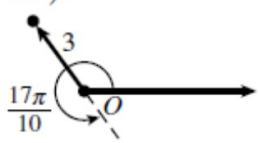
8. $(2, 5\pi/6)$

10. $(-3, 17\pi/10)$

8. $\left(2, \frac{5\pi}{6}\right)$



10. $\left(-3, \frac{17\pi}{10}\right)$



In Exercises 15–22, find the rectangular coordinates of the point with given polar coordinates.

16. $\left(\frac{5}{4}\sqrt{2}, \frac{5}{4}\sqrt{2}\right)$

16. $(2.5, 17\pi/4)$

18. $(-2, -14\pi/5)$ (1.62, 1.18)

In Exercises 23–26, polar coordinates of point P are given. Find all of its polar coordinates.

24. $P = (1, -\pi/4)$

26. $P = (-2.5, 50°)$

In Exercises 27–30, rectangular coordinates of point P are given. Find all polar coordinates of P that satisfy

(a) $0 \le \theta \le 2\pi$ **(b)** $-\pi \le \theta \le \pi$ **(c)** $0 \le \theta \le 4\pi$

27. $P = (1, 1)$

28. $P = (1, 3)$

29. $P = (-2, 5)$

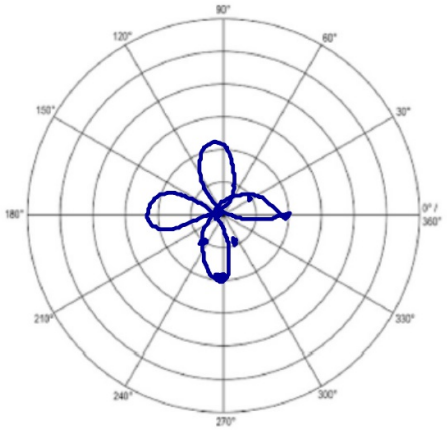
30. $P = (-1, -2)$

28. (a) $(\sqrt{10}, 1.25)$ or $(-\sqrt{10}, 4.39)$ **(b)** $(\sqrt{10}, 1.25)$ or $(-\sqrt{10}, -1.89)$
(c) The answers from part (a), and also $(\sqrt{10}, 7.53)$

30. (a) $(-\sqrt{5}, 1.11)$ or $(\sqrt{5}, 4.25)$ **(b)** $(-\sqrt{5}, 1.11)$ or $(\sqrt{5}, -2.03)$
(c) The answers from part (a), plus $(-\sqrt{5}, 7.39)$ or $(\sqrt{5}, 10.53)$

Graph r = 2cos(2θ). Use the T-table to plot points in radians from 0-2π
(use one of your polar graphs from the guided notes)

$2\cos(2(0))$
$2\cos(2(30))$



r	θ
2	0
1	30
0	45
-1	60
-2	90
-1	120
0	135
1	150
2	180

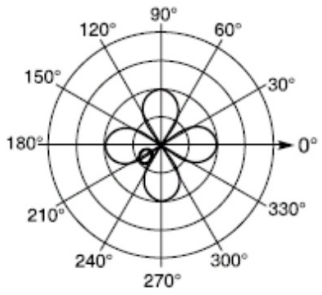
Graphs of Polar Equations

A **polar graph** is the set of all points whose coordinates (r, θ) satisfy a given polar equation. The position and shape of polar graphs can be altered by multiplying the function by a number or by adding to the function. You can also alter the graph by multiplying θ by a number or by adding to it.

Example 1 **Graph the polar equation $r = 2 \cos 2\theta$.**

Make a table of values. Graph the ordered pairs and connect them with a smooth curve.

θ	$2 \cos 2\theta$	(r, θ)
0°	2	(2, 0°)
30°	1	(1, 30°)
45°	0	(0, 45°)
60°	−1	(−1, 60°)
90°	−2	(−2, 90°)
120°	−1	(−1, 120°)
135°	0	(0, 135°)
150°	1	(1, 150°)
180°	2	(2, 180°)
210°	1	(1, 210°)
225°	0	(0, 225°)
240°	−1	(−1, 240°)
270°	−2	(−2, 270°)
300°	−1	(−1, 300°)
315°	0	(0, 315°)
330°	1	(1, 330°)



This type of curve is called a *rose*. Notice that the farthest points are 2 units from the pole and the rose has 4 petals.

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In Exercises 45–48, find the length of each petal of the polar curve.

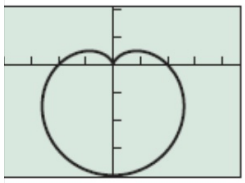
45. $r = 2 + 4 \sin 2\theta$

46. $r = 3 - 5 \cos 2\theta$

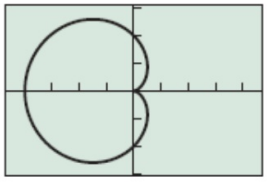
47. $r = 1 - 4 \cos 5\theta$

48. $r = 3 + 4 \sin 5\theta$

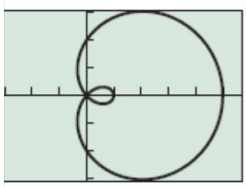
Exercises 9–12, match the equation with its graph without using your graphing calculator.



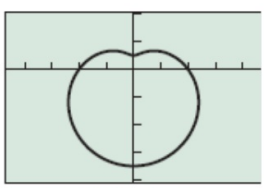
[–4.7, 4.7] by [–4.1, 2.1]
(a)



[–4.7, 4.7] by [–3.1, 3.1]
(b)



[–3.7, 5.7] by [–3.1, 3.1]
(c)



[–4.7, 4.7] by [–4.1, 2.1]
(d)

9. Does the graph of $r = 2 + 2 \sin \theta$ or $r = 2 - 2 \cos \theta$ appear in the figure? Explain.

10. Does the graph of $r = 2 + 3 \cos \theta$ or $r = 2 - 3 \cos \theta$ appear in the figure? Explain.

11. Is the graph in (a) the graph of $r = 2 - 2 \sin \theta$ or $r = 2 + 2 \cos \theta$? Explain.

12. Is the graph in (d) the graph of $r = 2 + 1.5 \cos \theta$ or $r = 2 - 1.5 \sin \theta$? Explain.